

Research Needs In Highway Transportation

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INTRODUCTION

A homespun philosopher, whose name has been long lost in the mists of time, once observed that “no one ever pulled a rabbit out of a hat without carefully putting one there in the first place.”

This little metaphor extolling the virtues of advance planning unfortunately has not always guided those of us in the business of highway research. Unquestionably, significant advances in highway transportation—the rabbits, if you will—have been made through research, but all too few of them have been the product of a carefully organized and coordinated long-range plans with clearly defined goals that reflect the real needs of those who financially support the research.

How much research, for example, is done by graduate students on the refinement of widgets—not because they critically need refinement but because the student’s major professor is the world’s top widget man? How much research is still underway on the strength of concrete simply because it is relatively easy to do and readily understood by engineers to *be* what they call research? I suppose these are valid reasons for doing certain research work, but they are not *good* reasons.

Every research job should have as its objective either the improvement of some part of a larger system or the development of fundamental knowledge that, hopefully, can later be used in system improvement. Whether or not there is a need for a particular research can then be determined, at least partly, by comparing it with other potential researches on the basis of likely improvement to the larger system versus cost in dollars, manpower, time, etc.

Many will take issue with me—they will argue that the widget expert should be permitted (and funded) to continue ad infinitum with his real love. I contend that if the man really has research talent he can and

* The opinions expressed herein are those of the author and do not necessarily reflect the views of the Highway Research Board.

should transfer his affections to new problems, solutions of which promise more real payoff towards improvement of the broad system in which he is qualified to work.

This calls for a broad structure defining the system and subsystems involved—or, from the research administrator's point of view, the identification of the weak points in the system that may be expected to respond to research. This is what we have called a structure of research needs.

Agreement on what the structure should look like, on what the most pressing needs are, or on priorities for research is not easy to come by nor is it absolutely essential. The exercise of trying to reach such agreement is in itself worthwhile because it forces administrators, operating personnel and researchers all to look beyond their immediate, day-to-day problems and interests and thus to broaden their viewpoints.

ORGANIZATIONS CONDUCTING HIGHWAY RESEARCH

One of the problems has been—and it is still with us—the diversity of the organizations involved in conducting highway research.

Because the individual state highway departments are charged with designing, building, operating, and maintaining the bulk of America's road mileage, it is not surprising to note that the highway departments of all 50 states, the District of Columbia and Puerto Rico are pursuing, through research, problems affecting their responsibilities.

On the federal level, the Bureau of Public Roads has a very busy office of research and development. Other federal agencies involved directly or indirectly with highway research are the Department of Housing and Urban Development, the U. S. Forest Service, the Public Health Service, the U. S. Army Corps of Engineers, the Census Bureau, the Department of Defence, etc.

On the local level, many of the larger cities are conducting research programs, especially in the areas of traffic safety and operation.

American industry—that considerable portion of it which manufactures material and equipment or supplies services for the field of highway transportation—is very heavily engaged in research which is pointed not only toward benefits for the companies involved, but for the highway user as well.

Many colleges and universities—certainly Purdue is an outstanding example—have continuing highway research programs conducted either unilaterally or in concert with government agencies and private industry.

Highway-oriented trade associations, professional organizations, and

non-profit agencies and foundations also make contributions to research through either their own efforts or through studies that they sponsor.

It is obvious, then, that highway research in this country is being conducted on no small scale and that many different viewpoints as to research needs must exist.

HIGHWAY RESEARCH BOARD ESTABLISHED

The Highway Research Board was established nearly 50 years ago to help weave the threads of all this research into a meaningful national tapestry. On November 11, 1920 the Bureau of Public Roads and the American Association of State Highway Officials, together with a number of highway-oriented industries and educational institutions created the board to act as a research "clearinghouse."

HRB Responsibilities

Essentially, the three primary responsibilities with which the board was charged in 1920, and which guide its efforts today, were:

1. To prepare a continuing and comprehensive national plan for highway research;
2. To assist existing organizations in coordinating their activities consistent with that plan; and
3. To collect and distribute information about current and completed research.

To insure the Board's objectivity and ability to do the job it was from the outset established as an arm of the old and highly-respected National Academy of Sciences, a private organization that seeks to further science for the public good.

Between 1920 and the mid-1950's highway research projects that had more than strictly parochial interest were, in general, stimulated as the result of activity by the board's highly-developed department and committee structure.

HRB Departments and Committees

The board has eight departments which are concerned individually with the broad areas of highway Economics, Finance and Administration; Design; Materials and Construction; Maintenance; Traffic and Operations; Soils, Geology and Foundations; Urban Transportation Planning; and Legal Studies.

Under each of these departments are a number of technical committees, each concerned with a relatively narrow subject area that logically

falls under the broader departmental responsibility. For example, the Committee on Photogrammetry and Aerial Surveys comes under the Department of Design, while the Committee on Road User Characteristics falls under the purview of the Department of Traffic and Operations. There is currently a total of 115 such committees.

HRB Committee Members and Research

The members of these committees are selected from among the most outstanding minds available in the state highway departments, federal agencies, state and local governments, educational institutions consulting firms, trade associations, and other highway and transportation-oriented groups. Over 1500 such individuals volunteer their time and talent to identify research needs in their respective fields to encourage research to meet these needs, to correlate and evaluate such research, to interpret the research findings, and much, much more.

Essentially, then, the Highway Research Board's committees form a vast talent pool that fosters research in all areas of highway transportation through well-planned cooperative effort and makes known the findings through various channels provided by the board to those who can best put them to use.

It was through the work of these committees over the years that many of America's highway problems were brought into focus and eventually solved through research activity that these same committees also stimulated.

THE NATIONALLY ORIENTED RESEARCH PLAN

But there was something lacking in this approach. First, no really overall comprehensive plan had been developed. There was, to be sure, cooperation and understanding among departmental committees, but research simply was not being undertaken on the basis of a logical pattern of predetermined need and priority. The single event that changed all this quite radically was the signing of the Federal-Aid Highway Act of 1956. This marked a new era of federal-state cooperation and with it came the impetus to buckle down to the task of coming up with a broad, nationally-oriented research plan.

In June of 1958 the Executive Committee of the Highway Research Board, as the direct result of a report submitted by a Subcommittee on Research Needs and Project Initiation, adopted the following resolution:

"The chairman of the board is to name a committee of top research men in the highway field consisting of a representative of the

Bureau of Public Roads, a representative from the universities, and three men from state highway departments to screen all available research data, set priorities, and estimate costs to get a program of highway research into motion as quickly as possible."

Thus, the Special Committee on Highway Research Priorities was born to delineate the nation's most urgent highway research needs. The result of this committee's year-long study was the Highway Research Board's Special Report No. 55, called *Highway Research in the United States—Needs, Expenditures, and Applications*.

Special Report 55

Special Report 55 defined nineteen broad areas in the field of highway transportation in which the initiation of research activity was considered vital and urgent. The committee, assuming such a program would extend over a four- or five-year period, estimated the total cost to be about \$34 million. For each research area mentioned the report suggested, in general terms, appropriate sources of financing.

Also included in this historic report were three appendices prepared by the Highway Research Board staff. Appendix A was *An Analysis of Current Fiscal Support* that provided a state-by-state summary and analysis of the 1958 expenditures for highway research. Appendix B was called *Research Problems of Importance* and actually described each of the more than 100 proposals for specific research that fell under the 19 broad subject areas. Appendix C was entitled *Application of Highway Research Findings* and described some 348 different uses made of research discoveries over the years.

Special Report 55 was indeed a big step forward in formally defining what needed to be done, and how it could be financed. While it did not provide an integrated, structured plan—a framework upon which a program could be based—it was very definitely a start in the right direction.

Special Report 55 also was rather broad in its scope and was aimed primarily at the research interests of the state highway departments. At the same time it was being compiled, the Bureau of Public Roads Office of Research and Development began gathering together a similar study related essentially to federal interests. This effort, incidentally, continues today and is an invaluable source of information on research needs.

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The next step forward in developing a comprehensive national program of highway research was indeed a giant one. In June of 1962 a

three-way agreement among the American Association of State Highway Officials, the Bureau of Public Roads, and the National Academy of Sciences, the board's parent organization, created the National Cooperative Highway Research Program.

The NCHRP, administered by the academy through the Highway Research Board, was brought into being to accelerate research into particularly acute national highway transportation problems. There is no question that this program has the greatest potential in the history of American highway research for coming up with the long-sought overall plan. The word "potential," is used because the NCHRP is still evolving; each year that goes by it is further refined and it will not be long before we have finally achieved that elusive goal we have been striving for so many years.

The first year of the NCHRP's operation, fiscal year 1963, saw a program encompassing six broad areas of research based upon the recommendations found in Special Report 55. These broad areas were broken down into projects by the board's advisory panels and ultimately resulted in 34 separate projects which were placed under contract with carefully selected research agencies.

Now entering its sixth year as a major force in solving these pressing problems concerning highway design, construction, maintenance, and operation, the unique NCHRP has been evoking increased enthusiasm.

The NCHRP is basically an AASHO program. All decisions concerning the direction of research activity are made by AASHO, although it certainly seeks and welcomes advice from the Highway Research Board. As a matter of fact, the original three-way agreement creating the program spelled this out:

"The Highway Research Board of the National Academy of Sciences is encouraged and expected to make such recommendations as it deems appropriate from time to time with regard to a vigorous and effective national program of highway research."

It was this charge that prompted the board to take a long, hard look at the NCHRP. It was obviously an effective program in a number of ways. The research being conducted indeed was coordinated by the states so that there would be no duplication. But something was still lacking. Some of the problems that formed the basis for the NCHRP, while urgent, were of a nature suited to attack more properly mounted by a single state rather than for inclusion in a national program. In addition, other highway research programs were not always fully considered. In short, the program that resulted often seemed fragmented with a less than desirable balance among the areas of greatest need.

Thus, in the fall of 1964 the board asked the chairmen of its eight departments to call upon their respective committees to determine and set forth the most pressing research problems that fell within the committee scopes and to attempt to establish some measure of priority of need. This effort, of course, was in effect an updating of the sort of thing gathered for Special Report 55. But there was a difference.

The board originally planned to take the statements and priorities developed by the committees and submit them to a high-level group of the board's senior department chairmen—men preeminent in their fields. This group, then, was to bring together the information into a balanced, research needs structure covering all aspects of highway transportation. At the same time, AASHO was very much interested in developing a similar strategy to improve the NCHRP and other research programs in which the state highway departments have a stake.

The upshot was the early realization by both groups that the task was simply too immense and complex for a voluntary group. It was at this point that it was decided to hand all the material over to consultants as a project in the NCHRP's fiscal 1966 program.

THE SMITH-TALLAMY REPORT

On April 1 of last year, after screening a number of proposals, the NCHRP awarded a \$100,000 contract to Wilbur Smith and Associates and Bertram D. Tallamy Associates, two of America's most prominent consulting firms in the highway field.

Early this past January, the board received a preliminary report from the researchers and it is now being reviewed by the appropriate NCHRP advisory panels, prior to publication this summer.

A discussion on the report's findings will shed a great deal of light on what direction we are going to have to take in the future.

The objectives of the Smith-Tallamy study were two-fold:

1. To develop a coordinated framework of needed short and long-range highway research.
2. To identify major areas of needed research and to arrange areas in the general framework along which future research could be organized.

To gather the necessary information to meet these objectives, the Smith-Tallamy people:

A. Reviewed existing published material, including the problem statements developed by the HRB committees and the research programs

of such organizations as the Bureau of Public Roads, American Society of Civil Engineers, American Public Works Association, Transportation Association of America and others.

B. Interviewed 150 executives, administrators and researchers for 59 organizations.

C. Conducted a symposium at Saratoga Springs, New York attended by 44 individuals representing a cross-section of the highway research talent of the nation.

National Transportation Research Goals

These efforts, in addition to staff conferences within the Smith-Tallamy organizations, resulted in a tri-leveled structure involving goals for total national transportation, goals for highway transportation specifically and goals for the NCHRP. On each of these levels, three major goals were developed.

With this as a brief resume, let me be more specific. First, the three so-called National Transportation Research Goals representing ultimate objectives. The three goals are:

1. To serve national commerce and defense by optimizing the development and function of an integrated national transportation system;
2. To improve national, regional and community development through the best possible transportation service and the integration of the transportation facilities with the community; and,
3. To foster national health and welfare as affected by transportation through increased safety and convenience, reduction of air and water pollution and noise abatement, and improved well-being of users and non-users.

Highway Transportation Research Goals

The second step in developing the structure involved goals and objectives specifically applicable to highway transportation, but derived from the total transportation concept. These highway transportation goals are:

1. To improve the adequacy and applicability of highway transportation as a part of an integrated transportation system;
2. To improve the role of highway transportation in optimizing land use and in urban development; and
3. To improve the identification and quantification of socio-political and economic factors in highway transportation.

NCHRP Research Goals

The third level of the structure involves the three basic goals that should be, according to Smith and Tallamy, the concern of the National Cooperative Highway Research Program:

1. To improve highway planning, design, construction as systems concepts;
2. To improve the safety, serviceability, and operations of the present highway system; and
3. To improve the integration of the highway with the community.

I think it is apparent that these NCHRP goals are really just a further subdivision of the highway transportation goals. With these objectives, the NCHRP can easily be coordinated as an effective part of a national research effort in the field of highway transportation.

NCHRP Goals and Major Problem Areas

The Smith-Tallamy report also lists under the three principal NCHRP goals some 13 specific major problem areas. The researchers point out that these are the problem areas that should receive current and major consideration in the immediate development of the NCHRP. These problem areas and the number of them will, of course, necessarily change as conditions change. For the present though, here they are:

Under goal No. 1, "To improve highway planning, design, and construction as systems concepts," the most pressing needed research involves:

1. Quality control of highway construction.
2. Design criteria for accommodation of maintenance.
3. Standards for relating levels of freeway service to economic and land use considerations.
4. Determination of the size, weight, and performance limits for highway vehicles.
5. Concepts and criteria for the integration of highways with other modes in the total transportation system.

Under goal No. 2, "To improve the safety, serviceability and operations of the present highway system," the problem areas listed are:

1. How best to accommodate or reduce light and sign standards, piers, guardrail and other such appurtenances within the right-of-way.
2. How to best use the maximum capacity of existing streets and highway systems.
3. How to improve operations on streets and highways at night and during other poor visibility periods.

4. How to better observe and control the traffic flow on urban street and highway systems.

Under goal No. 3, "To improve the integration of the highway with the community," the research effort should concentrate on:

1. Aesthetic considerations in the design, maintenance, and operation of highways;
2. The impact of various types or design features of highways on environmental values; and
3. Accommodation of multiple use of right-of-way in urban areas.

The report also assigns primary, secondary, and tertiary priorities to these problem areas and estimates the cost of the research at about \$46 million. This cost, of course, will be supplemented by the states' individual or group research activities as well as by the program of the Bureau of Public Roads.

Thus far the author has tried to show how the Smith-Tallamy Report has identified the prime research goals for the NCHRP and selected major problem areas under each goal.

The report goes one step further by tabulating in an Appendix over 900 research projects covering all of the problem areas. Over 700 of these projects were originally identified and defined by the departments and committees of the Highway Research Board.

RESEARCH FINDINGS PUT TO USE

This structuring procedure provides an effective means of organizing an otherwise uncoordinated collection of projects. It also permits the logical grouping or combining of small individual projects into major long-range programs.

But all of this will be of no avail if the findings of the research are not put to use. Too often in the past, research results in the highway transportation field remain unread in reports that merely gather dust in countless offices.

I submit that administrators and other "decision-makers" in the business of providing highway transportation for the nation—regardless of their level—have a responsibility to see that research findings are put to use.

The basic criterion for their decisions should be an understanding of the cost-benefit ratio involved. Industry research administrators must answer to the stockholders. In highway transportation, the administrators are no less responsible to their stockholders—the motoring public—who foot the bill.

This is not to say that nothing is being done. On this past Monday afternoon, here at the Road School, Mr. William Goodwin discussed in his paper the efforts currently underway to see that highway research is put to use.

But certainly all is not as efficient as it might be—and the NCHRP is no exception. For this reason, the Smith-Tallamy Report concludes that “as a significant and continuing part of the NCHRP, it is recommended that specific procedures be established for the effective application of the research findings. Without this vital step, much potentially vital data may fail to find its place (in the areas) where research payoff is properly measured.”

These procedures should be undertaken at the conclusion of each project and should include a formal list of recommendations to the sponsor—in the case of the NCHRP, the AASHO Research Evaluation Committee—for its action.

Generally speaking these recommendations should deal with the use of the research findings to:

1. Revise or modify existing specifications, policies or procedures;
2. Initiate advance field testing or developmental work to supplement the findings;
3. Continue the research efforts to explore more fully the potential of the findings; or
4. Discontinue further research in non-productive areas.

CONCLUSION

I hope it has been apparent that our efforts to come up with a meaningful long-range flexible structure for highway research needs have been productive.

The key word is flexibility because in the field of transportation today, changes in viewpoint and policies are occurring rapidly. Research programs must be able to accommodate these shifts in stride.